

Trend Study 29R-2-03

Study site name: Elephant Gap Livestock Exclosure.

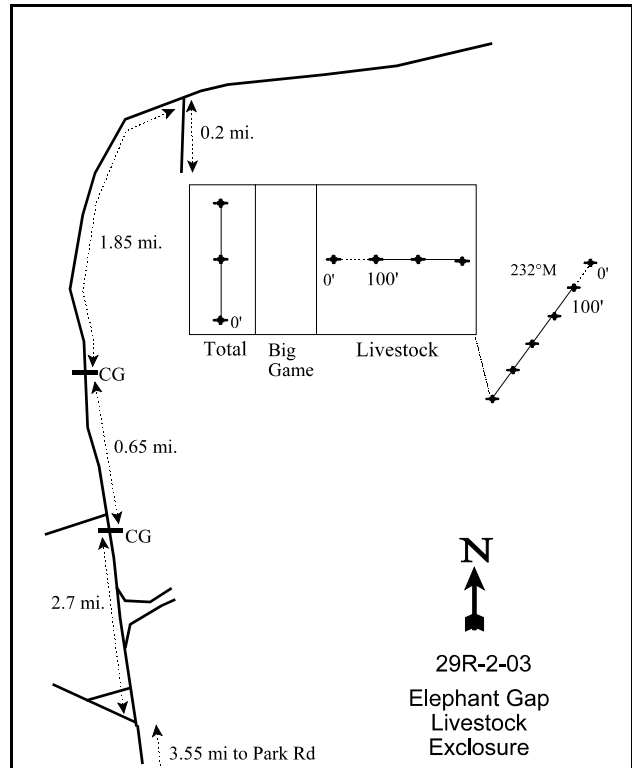
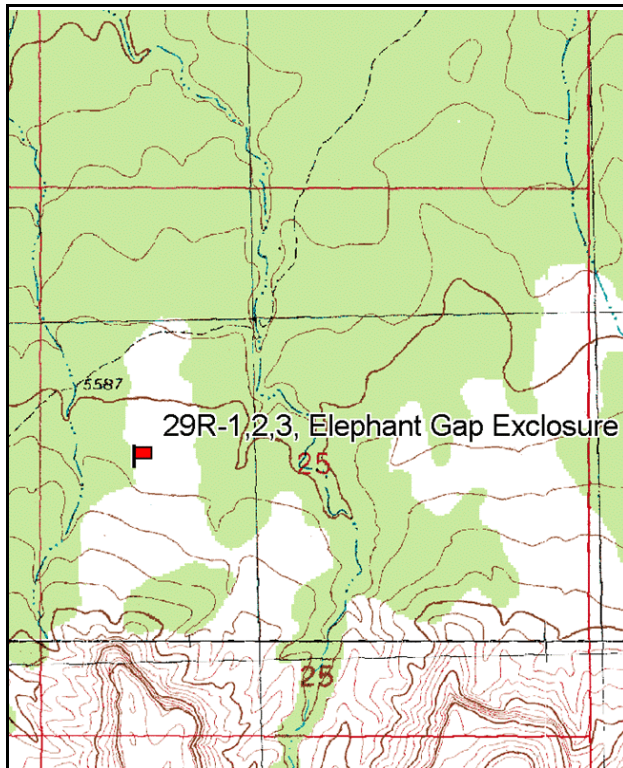
Vegetation type: Pinyon-Juniper.

Compass bearing: frequency baseline 90° degrees magnetic.

Frequency belt placement: line 1 (11ft and 95 ft), line 2 (59ft), line 3 (34 ft and 71 ft).

LOCATION DESCRIPTION

The starting point for this site is the entry to Coral Pink Sand Dunes State Park off of Hwy 89. From the entry of the park, travel south for 4.2 miles. Turn right and go 3.55 miles to a fork. Stay right and continue 2.7 miles to a cattleguard. Continue on main road for another 0.65 miles to another cattleguard. Drive another 1.85 miles to a faint road to the right (south). Drive on this road for 0.2 miles to the exclosure. The livestock exclosure is located on the east side of the exclosure complex. The baseline starts inside the livestock exclosure near the taller fence denoting the big game exclosure and runs through the middle of the exclosure (see map below).



Map Name: The Barracks

Diagrammatic Sketch

Township 42S, Range 9W, Section 25

GPS: NAD 27, UTM 12S 4110516 N, 339698

DISCUSSION

Elephant Gap Livestock Exclosure - Trend Study No. 29R-2

This study was established in 1998 inside the livestock exclosure at Elephant Gap. The Elephant Gap exclosure complex is located about 16 miles west-northwest of Kanab and about 9 miles northwest of the Coral Pink San Dunes State Park. The exclosure was built in the 1960's just north of Harris Point. Slope is 7% with a northwest aspect, and elevation is approximately 5,600 feet. The area is composed of an open pinyon-juniper woodland with a mixed shrub understory. Deer use this area as winter range and pellet group data estimated a high level of use within the livestock exclosure at 96 deer days use/acre (237 ddu/ha) in 1998 and 102 days use/acre (251 ddu/ha) in 2003.

Soil in the livestock exclosure is very similar to the total exclosure and outside. It is deep, sandy in texture, but strongly acidic (pH of 5.5). Phosphorus and potassium are limited at just 3.8 ppm and 3.2 ppm respectively, which may be limiting to plant growth and development. Values below 10 ppm for phosphorus and 70 ppm for potassium are considered deficient. There is very little rock or pavement on the surface or within the profile. Percent bare ground is similar to the total exclosure at 35% in 1998 and 40% in 2003, but cryptogamic cover is about twice as high inside the livestock exclosure. In 1998, average soil temperature was high at 71°F at 18 inches in depth. Combined with the sandy nature of the soil, high soil temperatures cause rapid drying of the soil profile which effectively limits shallow rooted plants. There is some soil pedestalling around shrubs, but erosion does not appear to be a problem due to the gentle terrain and high infiltration capacity.

Total shrub cover is similar to the total exclosure yet composition differs considerably. The key browse species consist of basin big sagebrush and green ephedra. Basin big sagebrush accounted for 24% and 10% of the browse cover in 1998 and 2003 respectively, while green ephedra provided 41% and 51% of the browse cover in the same years. The decline in basin big sagebrush cover in 2003 was the result of a large die-off. Sagebrush density was estimated at 1,180 plants/acre in 1998, declining to 740 in 2003. Not only did the number of dead sagebrush increase in 2003, but percent decadence increased from 46% to 95%, and young recruitment decreased from 7% to 0%. More than half of the remaining sagebrush (57%) were classified as having poor vigor in 2003. Annual leader growth on basin big sagebrush averaged 2.2 inches in 2003.

Green ephedra density numbered 1,060 plants/acre in 1998 and 900 in 2003. This population has maintained good vigor, low to moderate decadence, and light use. Young ephedra were very abundant in 1998 as they made up 53% of the population. In 2003, the ephedra population was mostly mature with less young (11%). Mature plants are large averaging about 4 feet in height and 5 feet in width. A few bitterbrush plants occur in the livestock exclosure but only numbered 20 plants/acre in 2003. Bitterbrush leaders averaged 5.1 inches of annual growth in 2003. Other shrubs found on the site include sand sagebrush, coin buckwheat, prickly pear cactus, and yucca. Juniper trees are scattered in the livestock exclosure at a density of 29 trees/acre. Overhead canopy cover averaged 14% in 2003.

Grass composition in the livestock exclosure closely resembles that of the total exclosure, but forbs are more diverse and were much more abundant in 1998. Sand dropseed was the most abundant grass in 1998, with pale evening primrose, toadflax, and milkvetch being the most common forbs. With drought in 2003, grasses and forbs declined in abundance, especially perennial forbs. Total forb cover was estimated at only 3% in 2003 compared to 11% in 1998. Sum of nested frequency of perennial grasses only slightly decreased in 2003, but perennial forbs showed a 56% decline in that category. The largest loss came from primrose, but toadflax and milkvetch also showed declines.

1998 APPARENT TREND ASSESSMENT

Soil at the site appears stable. There is a high amount of bare soil (35%), but erosion is minimal due to the gentle terrain combined with the high infiltration capacity of the soil. The key browse species are basin big sagebrush and green ephedra. Sagebrush appears to be in a state of decline even though utilization is mostly light. Forty-eight percent of the population is dead, percent decadence is at 46%, and nearly half (48%) of the decadent sagebrush appear to be dying. Reproduction is poor and not adequate to maintain the stand at current levels. The less preferred green ephedra population is healthy and appears to be increasing. Utilization is light, vigor normal, and percent decadence low at only 2%. The most preferred shrub on the site is antelope bitterbrush, but it only occurs in small numbers within the livestock enclosure. The population is mostly young and lightly utilized. The herbaceous understory is similar to the total enclosure with respect to grass diversity and abundance. Sand dropseed is the most abundant species followed by six weeks fescue. Forbs are more diverse and produce 3 times more cover compared to the total enclosure. Common species include pale and prairie evening primrose, milkvetch, and bastard toadflax.

2003 TREND ASSESSMENT

Trend for soil is slightly down. Bare soil increased from 35% to 40%, and vegetation cover declined from 38% to 26%. Cryptogamic cover also declined by nearly half. These changes result in less protective cover on the soil surface. Erosion is low because of high infiltration rates and the gentle slope. The key browse species, basin big sagebrush and green ephedra, have lower population densities, higher decadence, and lower recruitment. The decadence rate for sagebrush is extreme at 95%, and 60% of these plants were classified as dying which will likely result in further population losses in the future. Fifty-seven percent of the basin big sagebrush sampled were classified as having poor vigor in 2003, while most of the ephedra population maintained normal vigor. Ephedra is in better condition than sagebrush and since it accounts for half of the browse cover and has a higher density estimate, trend for browse is only slightly down. Trend for the herbaceous understory is down. Grasses provide little cover to the site and remained nearly stable in frequency. Perennial forbs showed a large decline in sum of nested frequency with drought in 2003. The largest loss came from pale evening primrose, but toadflax and milkvetch also showed decreases in their respective frequencies. The negative effect of drought on both sagebrush and the herbaceous species is obvious, and a return to normal precipitation patterns will help reverse these trends.

TREND ASSESSMENT

soil - slightly down (2)

browse - slightly down (2)

herbaceous understory - down (1)

HERBACEOUS TRENDS --

Management unit 29R, Study no: 2

Type	Species	Nested Frequency		Average Cover %	
		'98	'03	'98	'03
G	<i>Bouteloua gracilis</i>	7	11	.30	.34
G	<i>Bromus tectorum</i> (a)	_b 11	_a -	.08	-
G	<i>Muhlenbergia pungens</i>	4	3	.01	.03
G	<i>Oryzopsis hymenoides</i>	3	6	.06	.09
G	<i>Sitanion hystrix</i>	1	-	.00	-

Type	Species	Nested Frequency		Average Cover %	
		'98	'03	'98	'03
G	<i>Sporobolus cryptandrus</i>	_b 34	_a 21	1.11	.58
G	<i>Vulpia octoflora</i> (a)	_b 51	_a -	.44	-
Total for Annual Grasses		62	0	0.52	0
Total for Perennial Grasses		49	41	1.49	1.04
Total for Grasses		111	41	2.01	1.04
F	<i>Artemisia dracunculus</i>	2	-	.06	-
F	<i>Astragalus</i> spp.	56	38	1.74	1.62
F	<i>Castilleja linariaefolia</i>	-	-	.03	-
F	<i>Carduus nutans</i> (a)	-	2	-	.03
F	<i>Chaenactis douglasii</i>	5	-	.03	-
F	<i>Comandra pallida</i>	_b 88	_a 64	1.35	.52
F	<i>Cordylanthus parviflorus</i>	5	-	.09	-
F	<i>Cordylanthus</i> spp. (a)	-	7	-	.29
F	<i>Descurainia pinnata</i> (a)	_b 16	_a -	.11	-
F	<i>Dithyrea wislizenii</i> (a)	4	-	.09	-
F	<i>Draba</i> spp. (a)	13	-	.07	-
F	<i>Eriogonum cernuum</i> (a)	_b 11	_a -	.12	-
F	<i>Euphorbia</i> spp.	_B 14	_a -	.02	-
F	<i>Gilia</i> spp. (a)	1	6	.03	.02
F	<i>Lappula occidentalis</i> (a)	-	-	.00	-
F	<i>Oenothera albicaulis</i> (a)	_b 18	_a -	.60	-
F	<i>Oenothera pallida</i>	_b 155	_a 42	6.51	.45
F	<i>Penstemon</i> spp.	-	4	-	.03
F	<i>Phlox longifolia</i>	2	-	.00	-
F	<i>Sphaeralcea parvifolia</i>	_b 11	_a -	.21	-
Total for Annual Forbs		63	15	1.03	0.34
Total for Perennial Forbs		338	148	10.07	2.64
Total for Forbs		401	163	11.11	2.99

Values with different subscript letters are significantly different at $\alpha = 0.10$

BROWSE TRENDS --

Management unit 29R, Study no: 2

Type	Species	Strip Frequency		Average Cover %	
		'98	'03	'98	'03
B	Artemisia filifolia	3	2	.93	.78
B	Artemisia tridentata tridentata	47	26	4.79	2.14
B	Chrysothamnus nauseosus hololeucus	0	1	-	-
B	Ephedra viridis	23	24	8.32	11.07
B	Eriogonum nummularre	1	2	.03	.15
B	Juniperus osteosperma	1	1	5.21	6.52
B	Opuntia spp.	2	2	-	.06
B	Pediocactus simpsonii	0	0	-	.15
B	Purshia tridentata	2	1	.66	.53
B	Yucca spp.	2	3	.15	.41
Total for Browse		81	62	20.11	21.83

CANOPY COVER, LINE INTERCEPT --

Management unit 29R, Study no: 2

Species	Percent Cover	
	'98	'03
Artemisia filifolia	-	.61
Artemisia tridentata tridentata	-	.95
Ephedra viridis	-	16.64
Juniperus osteosperma	4.80	14.00
Purshia tridentata	-	1.18
Yucca spp.	-	.45

KEY BROWSE ANNUAL LEADER GROWTH --

Management unit 29R, Study no: 2

Species	Average leader growth (in)
	'03
Artemisia tridentata tridentata	2.2
Purshia tridentata	5.1

BASIC COVER --

Management unit 29R, Study no: 2

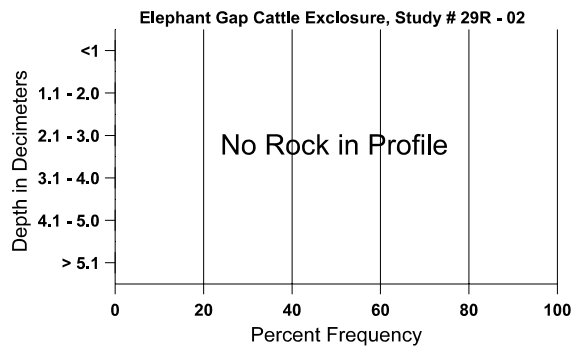
Cover Type	Average Cover %	
	'98	'03
Vegetation	37.53	25.90
Rock	.00	.00
Pavement	.08	0
Litter	42.49	42.98
Cryptogams	13.53	7.22
Bare Ground	34.80	40.44

SOIL ANALYSIS DATA --

Management unit 29R, Study no: 2, Study Name: Elephant Gap Livestock Exclosure

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%OM	PPM P	PPM K	ds/m
25.7	70.8 (17.7)	5.5	90.7	2.7	6.6	0.6	3.8	3.2	0.8

Stoniness Index



PELLET GROUP DATA --

Management unit 29R, Study no: 2

Type	Quadrat Frequency		Days use per acre (ha)	
	'98	'03	'98	'03
Rabbit	-	7	-	-
Deer	47	29	96 (237)	102 (251)

BROWSE CHARACTERISTICS --

Management unit 29R, Study no: 2

		Age class distribution (plants per acre)					Utilization				
Y e a r	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% poor vigor	Average Height Crown (in)
<i>Artemisia filifolia</i>											
98	60	-	-	20	40	-	0	0	67	33	47/51
03	40	-	-	20	20	-	50	0	50	0	43/47
<i>Artemisia tridentata tridentata</i>											
98	1180	60	80	560	540	1060	15	0	46	24	37/38
03	740	-	-	40	700	1480	35	46	95	57	26/24
<i>Chrysothamnus nauseosus hololeucus</i>											
98	0	-	-	-	-	-	0	0	-	0	-/-
03	20	-	-	20	-	-	100	0	-	0	37/50
<i>Echinocereus spp.</i>											
98	0	-	-	-	-	-	0	0	-	0	-/-
03	0	-	-	-	-	-	0	0	-	0	31/23
<i>Ephedra viridis</i>											
98	1060	280	560	480	20	40	0	0	2	0	52/81
03	900	-	100	600	200	20	4	0	22	7	43/63
<i>Eriogonum nummularre</i>											
98	20	-	-	20	-	-	0	0	-	0	26/35
03	40	-	-	40	-	-	0	0	-	0	14/19
<i>Juniperus osteosperma</i>											
98	20	-	-	20	-	-	0	0	-	0	-/-
03	20	-	-	20	-	-	0	0	-	0	-/-
<i>Opuntia spp.</i>											
98	40	-	-	40	-	-	0	0	0	0	4/9
03	40	-	-	20	20	-	0	0	50	50	4/11
<i>Purshia tridentata</i>											
98	60	-	40	20	-	-	0	0	-	0	36/44
03	20	-	-	20	-	-	0	100	-	0	48/61
<i>Tetradymia canescens</i>											
98	0	-	-	-	-	-	0	0	-	0	-/-
03	0	-	-	-	-	-	0	0	-	0	35/35
<i>Yucca spp.</i>											
98	100	-	20	80	-	-	0	0	-	0	24/17
03	100	-	-	100	-	40	0	0	-	0	28/28

ELEPHANT GAP EXCLOSURE COMPARISON SUMMARY

Soil conditions are very similar between grazing effects. The soil is deep with a sandy texture and a slightly acidic to strongly acidic pH (5.4 to 6.2). Phosphorus and potassium appear to be limiting to plant growth and development on all sites, with some values well below 10 ppm for phosphorus and 70 ppm for potassium. Organic matter is low over all treatments. Percent bare ground is high on all sites, but highest outside of the exclosures at over 50% in 2003. Vegetation cover was highest in the livestock exclosure in 1998, with similar amounts outside and in the total exclosure. In 2003, the livestock and total exclosures had similar vegetation cover estimates, while outside was considerably less. Cryptogamic crusts were abundant outside and in the livestock exclosure at over 10% in 1998 and 7% in 2003. Soil temperatures are high on all sites averaging about 70°F. High soil temperatures combined with the high infiltration rates of the soil result in rapid soil drying in the surface horizons. This could be limiting to the establishment of shallow rooted plants. Soil erosion on all treatment effects appears to be minimal due to the levelness of the terrain, combined with the high infiltration capacity of the soil.

The key browse species for all grazing effects is basin big sagebrush and green ephedra. Antelope bitterbrush is the most preferred but it occurs in very low densities and is not abundant enough to be considered a key species at Elephant Gap. It's highest density occurs inside the total exclosure where big game and livestock do not have access. Basin big sagebrush density is similar between all 3 grazing effects ranging from about 1,200-1,500 plants/acre in 1998. Sagebrush density declined in all 3 treatments in 2003 with the largest decrease coming outside. The number of dead sagebrush increased in all 3 treatments in 2003, nearly doubling inside the total exclosure and outside. Dead sagebrush now outnumber live individuals on all 3 transects in 2003. Sagebrush recruitment was lowest in the livestock exclosure in 1998 at 7%, and highest in the total exclosure at 17%. Recruitment decreased in all 3 treatments in 2003, but remained fair in the total exclosure and outside at 11%. Percent decadence was average inside the total exclosure at 19% in 1998, but moderately high in the livestock exclosure and outside at 46% and 45% respectively. In 2003, decadence increased to 53% in the total exclosure, 74% outside, and 95% in the livestock exclosure. Poor vigor was high on all 3 transects in 2003 ranging from 44%-57%.

Several factors appear to be effecting sagebrush at Elephant Gap. Drought is likely the primary driving force behind deteriorating sagebrush health, but winter injury could also be a factor. Winter injury is presumably caused by freezing due to a lack of sufficient cold hardiness and/or winter drought or dessication (Nelson and Tiernan 1983). During mild winters, sagebrush can break dormancy during the middle of the winter and begin growth too early in the year. By doing so, sagebrush plants become susceptible to dessication and crown death if temperatures become very cold for any substantial length of time. Sagebrush injury also occurs because available soil moisture is minimal during winter months, especially within these deep sandy soils. Sagebrush conditions inside the livestock exclosure and outside were worse compared to the total exclosure with higher decadence rates and a larger number of dead plants in 2003. It appears that use could be an additive factor in addition to drought and winter injury in these 2 grazing effects.

In 1998, green ephedra density was highest inside the livestock exclosure, intermediate outside, and lowest in the total exclosure. Density slightly declined in the exclosure treatments, but increased outside in 2003. The proportion of young ephedra plants was high in all 3 treatments in 1998, declining somewhat in the livestock exclosure and outside in 2003. No young were sampled in the total exclosure in 2003. Ephedra has maintained relatively good vigor in both surveys in all treatments, and decadence has been low to moderate.

The herbaceous understory is limited on all grazing effects, particularly grasses. In 1998 and 2003, total herbaceous cover in order of decreasing abundance was as follows: outside, livestock exclosure, and total exclosure. Grass composition is similar between all sites, with the most common perennial species being blue grama, sand dropseed, bottlebrush squirreltail, Indian ricegrass, and needle-and-thread. Annual grasses, cheatgrass and sixweeks fescue, were also sampled on all 3 sites in 1998. With drought conditions in 2003,

perennial grass nested frequency declined in all grazing effects, and sixweeks fescue was only sampled outside the exclosures. Forb composition is similar between treatment effects with respect to the dominant species, but more species are found in the livestock exclosure and outside. Forb cover was 3 times higher in both the livestock exclosure and outside the exclosure in 1998 than in the total exclosure. The most abundant forbs in 1998 were pale evening primrose, prairie evening primrose, toadflax, and milkvetch. Both primrose's and toadflax decreased on all 3 sites in 2003, with milkvetch remaining stable in the livestock and total exclosures, and increasing outside.